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MICROCIRCUIT, MONOLITHIC, DIGITAL  
HIGH SPEED CMOS/SOS  
  
SPECIFICATION FOR

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## CONTENTS

<u>Paragraph</u>	<u>Page</u>
1. SCOPE .....	3
1.1 Scope .....	3
1.2 Device Type .....	3
1.2.1 Case Outline .....	3
1.3 Manufacturer's Recommended Maximum Ratings .....	3
1.4 Manufacturer's Recommended Operating Conditions .....	3
2. APPLICABLE DOCUMENTS .....	4
2.1 Listing .....	4
2.2 Precedence .....	4
3. REQUIREMENTS .....	4
3.1 Individual Detail Specification .....	4
3.2 Item Requirements .....	4
3.3 Traceability .....	4
3.4 Design, Construction and Physical Dimensions .....	4
3.4.1 Terminal Connections .....	4
3.4.2 Functional Table .....	4
3.4.3 Case Outlines .....	5
3.5 Lead Material and Finish .....	5
3.6 Electrical Performance Characteristics .....	5
3.7 Electrical Test Requirements .....	5
3.7.1 Electrical Test Program .....	5
3.7.2 Radiation Testing .....	5
3.7.3 Delta Criteria .....	5
3.8 Marking .....	5
3.8.1 Serialization .....	5
3.9 Quality Assurance Requirements .....	5
4. QUALITY ASSURANCE PROVISIONS .....	5
4.1 Sampling and Inspection .....	5
4.1.1 Wafer Lot Acceptance .....	5
4.1.2 SEM Requirements .....	6
4.1.3 Internal Visual (Precap) .....	6
4.1.4 External Visual .....	6
4.2 Screening .....	6
4.2.1 Percent Defective Allowable (PDA) .....	6
4.3 Qualification Inspection .....	7
4.4 Quality Conformance Inspection .....	7
4.4.1 Group A Inspection .....	7
4.4.2 Group B Inspection .....	7
4.4.3 Group D Inspection .....	8
4.4.4 Group E Inspection .....	8
4.4.5 Destructive Physical Analysis (DPA) .....	8
4.5 Failure Analysis .....	8
4.6 Data Reporting .....	8
4.6.1 Data Report Format .....	9
4.7 Problem Notification .....	9
4.8 Control Units .....	9
4.9 JPL Source Inspection .....	9

5.	PACKAGING .....	9
5.1	Packaging Requirements .....	9
5.2	Electrostatic Discharge (ESD) Sensitivity .....	10
6.	NOTES .....	10
6.1	Intended Use .....	10
6.2	Ordering Data .....	10
6.3	Handling .....	10
6.4	Certificate of Conformance .....	10
6.5	Approved Sources of Supply .....	11

## TABLES

<u>Table</u>	<u>Page</u>
I. Screening and Quality Conformance Inspection Requirements .....	12
II. Delta Limits .....	13

## 1. SCOPE

1.1 Scope. This document describes the requirements for a family of high speed CMOS/SOS monolithic digital microcircuits. The requirements provide a level of microcircuit quality and reliability assurance for acquisition of microcircuits for JPL Mission Class A and B applications.

1.2 Device Type. The characteristics and/or requirements unique to each device type shall be as specified in the individual ST drawing hereinafter referred to as the detail specification.

1.2.1 Case Outline. The case outline shall be as designated in the detail specification and shown in MIL-M-38510, Appendix C.

1.3 Manufacturer's Recommended Maximum Ratings. The following data are for design information only.

Parameter	Rating
a. DC supply voltage range (V <sub>cc</sub> ): All voltage values reference to the V <sub>ss</sub> terminal .....	-0.5V to +7V
b. Input voltage range, all inputs .....	-0.5V to V <sub>cc</sub> + 0.5V
c. DC input current, any one input .....	±10 mA
d. DC drain current, any one output .....	±25 mA
e. Power dissipation per package (P <sub>D</sub> ); For Ta = -55 to +100°C .....	500 mW
For Ta = +101 to +125°C .....	Derate linearly at 12mW/°C to 200 mW
f. Device dissipation per output transistor; For Ta = Full package temperature range .....	100 mW
g. Storage temperature range (T <sub>stg</sub> ) .....	-65°C to +150°C
h. Lead temperature (during soldering) for package, at distance 1/16 ± 1/32 from case for 10 sec max. ....	265°C
i. Thermal resistance, junction to case .....	22°C/W

1.4 Manufacturer's Recommended Operating Conditions.

Parameter	Rating
a. Operating supply voltage range .....	4.5 to 5.5Vdc
b. Ambient operating temperature range .....	-55 to +125°C

## 2. APPLICABLE DOCUMENTS

2.1 Listing. The following documents, of the issue in effect on date of manufacture form a part of this specification to the extent specified herein. The Jet Propulsion Laboratory shall be substituted for reference to the U.S. Government.

### SPECIFICATION

#### Military

MIL-M-38510H	Microcircuits, General Specification for.
MIL-M-38510/750	Microcircuits, Digital, Advanced, CMOS, NAND Gates, Monolithic Silicon, Positive Logic

### STANDARD

#### Military

MIL-STD-883, Rev. C	Test Methods and Procedures for Microelectronics.
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2.2 Precedence. In the event of conflict between the text of this document and the documents referenced herein, the text of this document shall take precedence. In the event of conflict between the text of this document and the detail specification, the detail specification shall take precedence.

## 3. REQUIREMENTS

3.1 Individual Detail Specification. The requirements unique to each device type shall be as specified in the individual ST drawing hereinafter referred to as the detail specification.

3.2 Item Requirements. The individual item requirements shall be in accordance with MIL-M-38510 and as specified herein and in the applicable detail specification except that the requirements for change notification may be in accordance with MIL-M-38510 or MIL-STD-480 for Class I items only as defined in paragraph 1.2.1b(25) of MIL-STD-883. The manufacturer shall notify JPL of changes in product design or masks.

3.3 Traceability. Traceability shall be as specified in MIL-M-38510 for Class S microcircuits.

3.4 Design, Construction and Physical Dimensions. The design, construction, and physical dimensions shall be as specified in MIL-M-38510 except that epoxy (silver, Dupont 5504) die attach is permitted.

3.4.1 Terminal Connections. The terminal connections shall be as specified in the detail specification.

3.4.2 Functional Table. The functional table shall be as specified in the detail specification.

3.4.3 Case Outlines. The case outlines shall be as specified in the detail specification and paragraph 1.2.1 herein.

3.5 Lead Material and Finish. The lead or terminal material and finish shall be gold plated in accordance with MIL-M-38510.

3.6 Electrical Performance Characteristics. Unless otherwise specified, the electrical performance characteristics are as specified in Table III in the detail specification, and apply over the full recommended ambient operating temperature range.

3.7 Electrical Test Requirements. The electrical test requirements shall be the subgroups specified in Table I herein. The electrical tests for each subgroup are described in Table III in the detail specification.

3.7.1 Electrical Test Program. A copy of the test program in a readable format, with data taken on a subject device type over temperature, shall be supplied to JPL for review and approval. Only the JPL approved program shall be used for testing.

3.7.2 Radiation Testing. The parts shall be tested per paragraph 4.4.4 herein when specified in the contract or purchase order.

3.7.3 Delta Criteria. The electrical parameters identified in Table II herein shall be measured and recorded before and after each burn-in. After interim or final electrical parameter measurements, the change in the parameter (delta) shall be calculated between the initial electrical measurement and the present (interim or final) measurement.

3.8 Marking. Devices shall be marked with serial number, part number, ST number and date code in accordance with JPL detail specification. At the option of the manufacturer, marking of the country of origin may be omitted from the body of the microcircuit.

3.8.1 Serialization. All devices shall be serialized in accordance with MIL-M-38510, Class S quality level.

3.9 Quality Assurance Requirements. Microcircuits furnished in conformance to this specification shall have been subjected to, and passed all the requirements, tests and inspections including screening and quality conformance inspections as detailed in paragraph 4. herein and in the detail specification.

#### 4. QUALITY ASSURANCE PROVISIONS

4.1 Sampling and Inspection. Sampling and inspection procedures shall be in accordance with MIL-STD-883, Methods 5005 and 5007, as applicable, except as modified herein.

4.1.1 Wafer Lot Acceptance. Devices furnished under this specification shall be from wafer lots that are subjected to and successfully meet the wafer lot acceptance inspections and tests specified in MIL-STD-883, Method 5007.

4.1.2 SEM Requirements. Test slices from each wafer shall be submitted to scanning electron microscope (SEM) analysis in accordance with MIL-STD-883, Method 2018. Two inked dice from each wafer shall be supplied to JPL for independent verification.

4.1.3 Internal Visual (Precap). Precap inspection shall be in accordance with MIL-STD-883, Method 2010, condition A, except that semicircular cracks which are not in an active area and which start and end at the die edge are acceptable.

4.1.4 External Visual. External visual inspection shall be in accordance with MIL-STD-883, Method 2009.

4.2 Screening. Screening shall be in accordance with MIL-STD-883, Method 5004, level S and shall be conducted on all devices prior to quality conformance inspection. The following additional criteria shall apply:

- a. Delete the sequence specified in MIL-STD-883, Method 5004, 3.1.9 through 3.1.13, and substitute Table I, lines 1 through 7 herein.
- b. Static Burn-in Tests (MIL-STD-883, Method 1015). Static tests (test condition A and/or B) shall be done using the circuits shown in the detail specification or equivalent by JPL approval. Ambient temperature ( $T_A$ ) shall be  $125 \pm 8/-0^\circ\text{C}$ . Test duration shall be 96 hours minimum for each static burn-in. Time-temperature regression is not permitted.
- c. Dynamic Burn-in Test (MIL-STD-883, Method 1015). Dynamic test (test condition D) shall be done using the circuit shown in the detail specification or equivalent by JPL approval. Ambient temperature ( $T_A$ ) shall be  $125 \pm 8/-0^\circ\text{C}$ . Test duration shall be 240 hours minimum. Time-temperature regression is not permitted.
- d. Pre-burn-in, interim and final electrical parameters shall be as specified in Table III in the detail specification.

4.2.1 Percent Defective Allowable (PDA).

- a. The verified failures, excluding devices which fail only the delta limits, divided by the total number of devices in the lot initially submitted to burn-in, shall be used to determine the percent defective for the lot.
- b. The PDA for each inspection lot or subplot submitted to burn-in and interim electrical parameters shall be five percent (or one device, whichever is greater) cumulative across all burn-ins on all parametric failures. The PDA on functional failures (failing the functional/truth table test) shall be three percent or one device, whichever is greater.



- c. Unless otherwise specified, lots may be resubmitted one time and only when the observed percent defective does not exceed 20 percent. The PDA for the second submittal is five percent.

4.3 Qualification Inspection. Qualification inspection in accordance with MIL-M-38510 is not required.

4.4 Quality Conformance Inspection. Quality conformance inspection shall be in accordance with MIL-STD-883, Method 5005. Group A and B inspections shall be performed on each inspection lot in accordance with MIL-STD-883, Method 5005 (Table I and IIa) and as specified herein. Group D (MIL-STD-883, Method 5005 (Table IV) shall be performed on a periodic basis as specified in MIL-M-38510. Generic test data may be used to satisfy the requirements of group D inspections. Group E inspections shall be performed on each inspection lot in accordance with MIL-STD-883, Method 5005 (Table V) as specified in paragraph 4.4.4 herein.

4.4.1 Group A Inspection. Group A inspection shall consist of the test subgroups and sample values shown in MIL-STD-883, Table I, Method 5005, Class S, and as specified in Table I herein.

4.4.2 Group B Inspection. Group B inspection shall consist of the test subgroups and LTPD values shown in MIL-STD-883, Method 5005, Table IIa, Class S, and as follows:

- a. End-point electrical parameters shall be as specified in Table I herein.
- b. Steady state life test (MIL-STD-883, Method 1005) conditions:
  - 1) Dynamic test circuit. (Same as the screening dynamic test circuit.)
  - 2)  $T_A = +125 \pm 8/-0^\circ\text{C}$ .
  - 3) Test duration: 1000 hours minimum. No accelerated life testing shall be permitted.
  - 4) General inspection conditions of MIL-M-38510, paragraph 4.3, are acceptable.
  - 5) The LTPD shall be five, with initial acceptance number (c) of zero.
  - 6) The delta parameters of Table II shall be calculated for information only (not for lot jeopardy).
- c. Electrical reject parts from the lot shall be used for subgroups 1, 2, 3, and 4. Parts good at room temperature only may be used for subgroup 6. Subgroup 7 may be satisfied with generic data for the HCMOS/SOS logic family. The limit for subgroup 7 is 600V minimum.

- d. A new subgroup, "Subgroup 8, Ground Bounce Noise Test", shall be added to the Group B inspection. The intent of the ground bounce noise test is to gather information on the magnitude of logic level shift to expect in a non-switching output due to the simultaneous switching of all other outputs. Testing shall be per MIL-M-38510/750, Table I, Tests  $V_{GBL}$  and  $V_{GBH}$  with the following exceptions:

- 1) No limits shall be applied.
- 2)  $I_{OL}/I_{OH}$  test conditions shall be 10mA/-10mA rather than 24mA/-24mA respectively. There shall be no lot jeopardy associated with this test.

The manufacturer may meet this requirement by supplying generic data on a flip-flop, a gate, and a buffer within 6 months of issuance of the first order release for the respective part type or for one of a similar function.

4.4.3 Group D Inspection. Group D inspections shall consist of the test subgroups and LTPD values shown in MIL-STD-883, Method 5005, Table IV, Class S, and the end-point electrical parameters shall be as specified in Table III in the detail specification. (This requirement may be satisfied through generic data.)

4.4.4 Group E Inspection. Group E inspection shall be in accordance with (Class S) test procedures specified in MIL-STD-883, Method 5005, Table V. (Sample size = 4, no rejects.) The total dose shall be 100 krad (Si), unless otherwise specified. Post-irradiation electrical tests at 25°C shall be performed twice; limits shall be the 125°C limits of the JPL detail specification. The first measurement shall start within one hour after the end of the irradiation as specified in MIL-STD-883, Method 1019. The second measurement, for rebound (post-irradiation effect) analysis, shall be performed on the entire sample with devices stored for 10 +4/-0 days at room temperature with no bias applied.

4.4.5 Destructive Physical Analysis (DPA). JPL will perform destructive physical analysis including internal water vapor content analysis with appropriate lot jeopardy in accordance with MIL-STD-883, Method 5009 on fully screened parts. JPL will test two samples per MIL-STD-883, Method 3015 to gather information on the ESD Zap voltage,  $V_{ZAP}$ . Issues of lot jeopardy associated with the JPL DPA shall be resolved by informal discussion or Material Review Board action.

4.5 Failure Analysis. Failure analysis shall be performed by the vendor in accordance with the provisions of MIL-M-38510.

4.6 Data Reporting. A copy of the following data, as applicable, shall be supplied:

- a. Attributes data for all screening tests (see 4.2 herein) and read and record variables data for all screening burn-ins and steady state life tests (see 3.7 herein). (Screening tests for which data are required are those subsequent to encapsulation except as required herein.)

- b. X-ray report and one set of film (see Method 5004, 3.1.18).
- c. Scanning electron microscope (SEM) report with one copy of original photographs (see 4.1.2 herein).
- d. The quality conformance inspection data (see 4.4 herein).
- e. Final electrical parameters data (see 4.2d herein).
- f. Delta calculations for all parameters listed in Table II herein.
- g. Wafer acceptance test report (see 4.1.1 herein).
- h. Certificate of conformance.

4.6.1 Data Report Format. Data shall be identified by part type, test condition, program identification, lot number and serial number range. The required electrical data and delta analyses shall be presented in easily readable condition. One additional set of variables data and delta calculations shall be supplied on a magnetic medium in an ASCII fixed field format.

4.7 Problem Notification. The JPL technical representative shall be notified within one week of the occurrence of the following:

- a. A PDA failure of any resubmitted lot.
- b. Any parts failing Group B, D, or E tests.
- c. Other delays due to test equipment breakdown, test error or testing related problems.

4.8 Control Units. A control unit is a device identical to the test specimens which is not subjected to any stresses applied to the test specimens, but is used to verify the resolution, accuracy and repeatability of measurement equipment. Two control units shall be read and recorded before and after each read and record operation on the lot. An approach approved by MIL-M-38510 is acceptable as an alternate.

4.9 JPL Source Inspection. JPL will provide source inspection for preseat visual (to MIL-STD-883, Method 2010, Condition A) and preship review (including external visual inspection per MIL-STD-883, Method 2009, and review of the lot data books). The manufacturer shall provide 48 hour notification, unless otherwise specified, prior to parts arriving at the appropriate inspection point and an adequately equipped work station with electrostatic discharge (ESD) protection to perform the inspection.

## 5. PACKAGING

5.1 Packaging Requirements. The requirements for packaging shall be in accordance with MIL-M-38510.

5.2           Electrostatic Discharge (ESD) Sensitivity. The devices supplied in accordance with this specification shall be considered to be ESD sensitive and require further protection and shall use one of the packaging requirements in accordance with MIL-M-38510, Paragraph 5, Packaging, Category A.

6.           NOTES

6.1           Intended Use. The microcircuits shall be of a quality and reliability assurance level suitable for JPL mission Class A and Class B; both non-repairable, long duration, interplanetary space craft applications.

6.2           Ordering Data. The contract or purchase order should specify the following:

- a.       Vendor part number and JPL drawing number (see 6.5 herein).
- b.       Requirements for special carriers, lead lengths, or lead forming, if applicable. These requirements shall not affect the part number.
- c.       Requirement for inspection notification, if other than 48 hours (see 4.6 herein).
- d.       JPL Parts Trace Number.
- e.       Requirement for radiation tests and level if different from that stated herein. (See 3.7.2 herein.)

6.3           Handling. Electrostatic sensitive devices must be handled with certain precautions to avoid damage due to electrostatic charge. The following handling practices are recommended:

- a.       Devices should be handled on benches with conductive and grounded surfaces.
- b.       Ground test equipment, tools, and operator.
- c.       Do not handle devices by the leads.
- d.       Store devices in conductive foam or anti-static carriers.
- e.       Avoid use of plastic, rubber, or silk.
- f.       Maintain relative humidity above 50 percent, if practical.
- g.       Operator should be grounded when handling device.
- h.       Handlers and other such machinery should be grounded.

6.4           Certificate of Conformance. Certificate of conformance to this specification, signed by an authorized representative of the manufacturer, must accompany each shipment.

6.5        Approved Sources of Supply.    The following manufacturers are approved by JPL:

<u>Vendor CAGE No.</u>	<u>Vendor Name and Address</u>
34371	Harris Semiconductor P.O. Box 883 Melbourne, FL 32901
3T990	Marconi Circuit Technology Co Integrated Circuit Division 45 David's Drive Hauppauge, NY 11788

Table I. Screening and Quality Conformance Inspection Requirements

Line No.	Applicable Tests and MIL-STD-883 Test Methods	Subgroups
1	Pre burn-in electrical parameters (Method 5004)	1, 7, 9
2	Static Burn-in I	
3	Interim electrical parameters (Method 5004)	$\Delta$ 1, 7
4	Static Burn-in II	
5	Same as line 3	$\Delta$ 1, 7
5a	Static Burn-in III **	
5b	Same as line 3 **	$\Delta$ 1, 7
6	Dynamic burn-in	
7	Same as line 3	$\Delta$ 1*, 7
8	Final electrical parameters***	1, 2, 3, 7, 8, 9, 10, 11
9	Group A test requirements (Method 5005)	1, 2, 3, 7, 8, 9, 10, 11
10	Group B end-point electrical parameters (Method 5005)	$\Delta$ 1, 2, 3, 7, 8, 9, 10, 11
11	Group D end-point electrical parameters (Method 5005)	1, 2, 3, 7
12	Group E end-point electrical parameters (Method 5005)	1, 7

\* PDA applies to subgroup 1 and 7 (see 4.2.1)

\*\* When specified in the detail specification.

\*\*\* Subgroups 1, 2, 3, and 9 shall be read and recorded.

$\Delta$  Table II Delta criteria shall be calculated with reference to the line 1 electrical parameters measurement for screening burn-ins. For line 10, the delta calculations shall be made with reference to the Subgroup 5 pre-life test measurements.

Table II. Delta Limits

PARAMETER	$\Delta$ LIMIT
$I_{OH}$	$\pm 15\%$ of the initial reading
$I_{OL}$	$\pm 15\%$ of the initial reading
$I_{IH}, I_{IL}$	$\pm 50\text{nA}$
$I_{CC}$ (10 $\mu\text{A}$ limit)	$\pm 1.5\mu\text{A}$
$I_{CC}$ (20 $\mu\text{A}$ limit)	$\pm 2.0\mu\text{A}$
$I_{CC}$ (40 $\mu\text{A}$ limit)	$\pm 4.0\mu\text{A}$

Note: Deltas may be computed either from the initial measurement or from the last prior measurement point.

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